REMARKS

This application contains claims 1-75. Claims 1, 16, 26, 41, 51 and 66 have been amended. Claims 22, 47 and 72 have been canceled without prejudice. No new matter has been introduced. Reconsideration is respectfully requested.

Claims 1-8, 10, 13-22, 26-33, 35, 38-47, 51-58, 60 and 63-72 were rejected under 35 U.S.C. 103(a) over Itoh (U.S. Patent 5,740,320) in view of Aso (U.S. Patent 5,485,543). Claims 1, 16, 26, 41, 51 and 66 have been amended in order to clarify the distinction of the present invention over the cited art.

Itoh describes a method of text-to-speech synthesis by concatenation of representative phoneme waveforms selected from a memory. The representative waveforms are chosen by clustering phoneme waveforms recorded in natural speech, and selecting the waveform closest to the centroid of each cluster as the representative waveform for the cluster (abstract). As explained in response to the previous official action in this case, Itoh uses a "waveform compilation type speech synthesis method" (col. 3, lines 9-10), which operates in the time domain, unlike the feature-domain concatenation approach recited in the claims of the present patent application. In the present official action, the Examiner accepted Applicant's

position in this regard (page 4, line 11, in the present official action).

Aso describes a method and apparatus for speech analysis and synthesis. The apparatus comprises an analysis unit 1, which determines a short-period power spectrum of an input speech wave and samples the spectrum to obtain spectral envelope data. A parameter conversion unit 2 converts the envelope data into mel cepstrum coefficients. A synthesis unit 3 then generates a synthesized speech wave using the mel cepstrum coefficients as filter parameters (Fig. 1; col. 2, lines 55-67; and abstract).

Aso's synthesis unit, as shown in Fig. 4, comprises pulse and noise sound source generators 13 and 14 and a sound source switching unit for selecting the appropriate sound source according to whether the current frame is voiced or unvoiced. A synthesizing filter unit 16 filters the chosen sound source using the mel cepstrum coefficients (col. 3, lines 16-23). For voiced frames, the pulse sound generated produces the pulses at intervals indicated by the pitch, and the amplitude of the pulses is controlled by the first-order term of the mel cepstrum coefficients (col. 5, lines 19-25). In other words, in these embodiments, Aso creates a time-domain sequence of pulses (or of white noise), and uses the

mel cepstrum coefficients to filter the time-domain pulse sequence.

Aso shows another, different embodiment in Fig. 6, which performs "ruled" speech synthesis (col. 6, lines 7-9). In this embodiment, ruled synthesis unit 23 comprises a character line analysis unit 24, which analyzes an entered line of characters, and a rule unit 25, which generates a "parameter connecting rule," pitch information, and voiced/unvoiced information based on the results of the analysis in unit 24. A parameter connection unit 26 forms a time-sequential line of mel cepstrum coefficients according to the parameter connecting rule. A synthesis unit 27 then generates synthesized speech in the manner of unit 3 described above (Fig. 6; col. 6, lines 19-31).

In other words, in both embodiments, Aso forms a series of mel cepstrum coefficients in the time domain. He then generates a sequence of pulses and white noise, and applies the mel cepstrum coefficients as a filter to this time-domain sequence.

Claim 1, as amended, recites a method for speech synthesis using a segment inventory that comprises respective sequences of feature vectors for a plurality of speech segments. To synthesize an output speech signal, sequences of feature vectors are selected from the inventory. The selected

sequences of feature vectors are concatenated into an output series of feature vectors in the frequency domain, which are used to compute a series of complex line spectra of the output signal. The complex line spectra are then transformed to a time domain speech signal for output. The claim has been amended to incorporate the limitation, formerly stated in claim 22, that the feature vectors are concatenated in the frequency domain.

In other words, whereas Aso's speech synthesizer uses a time-domain series of mel cepstrum coefficients to filter a time-domain sequence of pulses (as explained above), claim 1, as amended, is directed explicitly to speech synthesis operations that take place in the feature and frequency domains. The claimed method transforms the frequency-domain series of feature vectors into a series of complex line spectra, which are defined explicitly in the specification as "the sequence of respective sine-wave amplitudes, phases and frequencies in a sinusoidal speech representation" (page 6, lines 12-16). This is the conventional meaning of "complex line spectra" that is generally accepted in the art.

Aso makes no mention or suggestion of the use of complex line spectra in the context of concatenative speech synthesis. In rejecting claim 1, the Examiner identified the

step of "computing a series of complex line spectra" with col. 4, lines 1-8; col. 2, lines 55-67; and col. 3, lines 15-22, in Aso. The cited passage in col. 2 simply describes Aso's system in general and does not explain how synthesis unit 3 actually operates. The other cited passages refer to sampling unit 7 in Aso's analysis unit 1 (col. 3, line 63 - col. 4, line 8) and to Aso's parameter conversion unit 2 (col. 3, lines 15-22), rather than to synthesis unit 3. The passages in Aso that do relate to the synthesis unit (col. 3, lines 16-23; col. 5, lines 14-39; and col. 6, lines 19-31), have nothing to do with frequency domain series of feature vectors or with complex line spectra, as required by claim 1.

In rejecting claim 22 (now canceled), the Examiner stated that forming a series of the feature vectors in the frequency domain reads on col. 7, lines 30-32, in Aso. This passage, taken from Aso's claim 3, states that "calculating [mel cepstrum coefficients from the spectrum envelope] comprises the step of applying an inverse Fast Fourier Transform process to the spectrum envelope to determine the cepstrum coefficients..." In other words, this passage also relates to the operation of Aso's parameter conversion unit 2, rather than to synthesis unit 3. Aso uses time/frequency transformations only in sampling and parameter conversion, and not in any of his actual speech synthesis steps.

Thus, to summarize, neither Itoh nor Aso teaches or suggests the steps of processing a selected sequence of feature vectors to generate a concatenated output series in the frequency domain, or using this series to compute a series of complex line spectra of the output signal. Therefore, claim 1 is believed to be patentable over the cited references. In view of the patentability of claim 1, claims 2-8, 10 and 13-15, which depend from claim 1, are believed to be patentable, as well.

Claim 16 recites a method for speech synthesis, in which the spectral envelopes of an input speech signal are estimated in a succession of time intervals during each segment of the speech signal. The spectral envelopes are integrated over a plurality of window functions in the frequency domain so as to determine elements of feature vectors. The feature vectors are then concatenated in order to reconstruct an output speech signal. The claim has been amended to incorporate the limitations of claim 22, now canceled, and now states, like claim 1, that the feature vectors are concatenated to form a series in the frequency domain, which is used in computing a series of complex line spectra of the output signal. The output signal is transformed to the time domain in order to reconstruct the output speech signal.

Thus, amended claim 16 is believed to be patentable over Itoh and Aso for the same reasons as were explained above in reference to claim 1. In view of the patentability of claim 16, claims 17-21, which depend from claim 16, are also believed to be patentable.

Independent claims 26 and 41 recite devices for speech synthesis, while independent claims 51 and 66 recite computer software products. The claimed devices and products operate on principles similar to the methods of claims 1 and 16, and these device and product claims have been amended in the same manner as claims 1 and 16. Therefore, for the reasons stated above, amended independent claims 26, 41, 51 and 66 are believed to be patentable over Itoh, as are claims 27-33, 35, 38-40, 42-46, 52-58, 63-65 and 67-71, which depend from these independent claims.

Claims 9, 11, 12, 23-25, 34, 36, 37, 48-50, 59, 61, 62, and 73-75 were rejected under 35 U.S.C. 103(a) over Itoh in view of Aso and further in view of one of Campbell (U.S. Patent 6,366,883), Mizuno et al. (U.S. Patent 6,334,106), Coorman et al. (U.S. Patent 6,665,641) and Matsumoto (U.S. Patent 5,940,795). In view of the patentability of the amended independent claims in this application, as explained above, dependent claims 9, 11, 12, 23-25, 34, 36, 37, 48-50, 59, 61, 62, 73-75 are believed to be patentable, as well.

Although Applicant has not specifically argued the patentability of the dependent claims, these dependent claims are believed to recite independently-patentable subject matter, notwithstanding the patentability of the independent claims. Arguments with respect to the dependent claims have been omitted in the interest of brevity.

Applicant believes the amendments and remarks presented hereinabove to be fully responsive to all of the grounds of rejection raised by the Examiner. In view of these amendments and remarks, Applicant respectfully submits that all of the claims in the present application are in order for allowance. Notice to this effect is hereby requested.

In view of the above amendments and remarks, Applicant respectfully requests reconsideration and withdrawal of the outstanding rejections of record. Applicant submits that the application is in condition for allowance and early notice to this effect is most earnestly solicited.

If the Examiner has any questions he is invited to contact the undersigned at 202-628-5197.

Respectfully submitted,

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